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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE:

X-RAY APPARATUS AND  
MAMMOGRAPHIC X-RAY  
APPARATUS WITH AN INDICATOR

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X-RAY APPARATUS, ESPECIALLY AND MAMMOGRAPHIC X-RAY  
APPARATUS, WITH COMPRISING INDICATING MEANS IN THE FORM OF  
LED SAN INDICATOR

[0001] The present patent document is a continuation of PCT Application Serial Number PCT/EP2005/052047, filed May 4, 2005, designating the United States, which is hereby incorporated by reference. The present patent document also claims the benefit of foreign application number DE 10 2004 023 046.3 filed on May 11, 2004, which is hereby incorporated by reference.

BACKGROUND

Field

[0002] The present ~~embodiments~~invention relates to an X-ray apparatus, such as in particular a mammographic X-ray apparatus. The apparatus includes, comprising an indicator, as generically defined by the preamble to claim 1 and as defined by the preamble to claim 2; an X-ray apparatus of this kind is known from German Patent Disclosure DE 199 43 898 A1.

Related Art

[0003] Generally, ~~M~~mammographic X-ray apparatuses have an indicator means, by which, bBefore the actual process of taking the X-ray images, the indicator projects an exemplary trace of the X-ray field ~~projected on the surface of a patient body and/or on an object table is.~~ The X-ray field is monitored, for instance example, to assure that the correct diaphragm has been chosen. As the indicator means, Conventionally, an incandescent bulb mounted laterally of the X-ray beam path is typically providedused. The beam of light from the incandescent bulb, extending that extends perpendicular to the X-ray beam path, is deflected into the direction of the X-ray beam by a mirror disposed in the X-ray beam path. ~~In~~During

the actual taking of the X-ray image, the mirror is folded out of the way of the beam path, or if it is radiotransparent, it stays in the beam path.

[0004] An X-ray apparatus of this kind is known from German Patent Disclosure DE 199 43 898 A1. ~~From According to DE 199 43 898 A1,~~ ~~particularly for X-ray apparatuses used as aids in surgery,~~ an indicator means in the form of laser diodes ~~are have been previously known used,~~ for example, for X-ray apparatuses used as aids in surgery. The indicators ~~which~~ are mounted either on the X-ray detector or on the X-ray source,~~;~~ Accordingly, in order to make the region, through which the X-radiation passes, for example, above the surface of the of the patient and/or the X-ray field on the surface of the patient, is visible (illuminated). The indicator ~~means are is~~ designed to be adaptable to the geometry of the X-ray beam,~~and especially, for example,~~ the size of the opening angle, for instance by sending a signal for changing the aperture of the diaphragm onward to the indicator ~~means~~.

#### SUMMARY

[0005] The present embodiments relate to an X-ray apparatus and a mammographic X-ray apparatus with an indicator. The present embodiments may obviate one or more of the problems due to the limitations and disadvantages of the related art. For example, one exemplary embodiment The object of the present invention, in such X-ray apparatuses and in particular mammographic X-ray apparatuses, is to make the illumination illuminates of the X-ray field, which precedes the actual making of the images themselves X-ray, simpler in a way that is simple and involves less little effort.

[0006] ~~Attaining this object can be done in an X-ray apparatus, in particular a mammographic X-ray apparatus, as generically defined by the preamble to claim 1 or to claim 2 by means of their respective definitive teachings; advantageous features are each the subject of the associated dependent claims.~~

[0006] In one exemplary embodiment, an X-ray apparatus includes an X-ray beam generated by an X-ray source and a diaphragm. At least one LED is disposed

as an indicator between the X-ray source and the diaphragm. The illuminating beam of the at least one LED is directed in an undeflected fashion onto the X-ray field, and the at least one LED is pivotable (swivable) out of the X-ray beam. The at least one LED is mounted on a filter array that is mounted between the X-ray source and the diaphragm. The X-ray apparatus, in particular a mammographic X-ray apparatus, of the invention, because of the mounting of the indicator means between the X-ray source and the diaphragm and because of the undeflected orientation of the illuminating beam, offers the advantage that Accordingly, the diaphragm is may not be also-used for shaping the beam of the X-ray beam and shaping the beam of the illuminating beam but instead, and thus deflecting the illuminating beam can be dispensed with/eliminated. Complicated control of the orientation of the indicator means is eliminated, and a mirror that can be folded away is unnecessary, making a compact, low-maintenance construction possible.

[0007] ~~In a way that is advantageous for the sake of a compact, simple construction of the X-ray apparatus, the~~In one exemplary embodiment, at least one LED is mounted on a filter array that is associated with the X-ray apparatus and is located between the X-ray source and the diaphragm. ~~Since i~~In most X-ray apparatuses (systems), the filter array is fundamentally present, All that is needed is a mount for the LED. If there are~~Alternatively, a plurality of LEDs surrounding the X-ray beam, then the LEDs are disposed on a common ring mount, in a way that is expedient for the sake of~~or especially simple mounting whenif there is a plurality of LEDs surrounding the X-ray beam.

#### DRAWINGS

[0009] ~~The invention as well as further advantageous features along with characteristics of the dependent claims will be described in further detail below and shown schematically in the drawings; shown are:~~

[0008] ~~Figure. 1, in~~ illustrates a side view, ~~of~~ a known mammographic X-ray apparatus with an incandescent bulb and deflection mirror ~~for illuminating that~~ illuminates an X-ray field;

[0009] ~~Figure. 2, in~~ illustrates a side view, ~~of~~ a mammographic X-ray apparatus ~~with apparatus with a plurality of LEDs on a ring mount for illuminating the X-ray field of the invention according to an exemplary embodiment, with a plurality of LEDs on a ring mount for illuminating the X-ray field;~~

[0010] ~~Figure. 3, in plan view, illustrates an the ring exemplary ring mount of~~ Fig. 2;

[0011] ~~Figure. 4, in~~ illustrates a side view, ~~of~~ a mammographic X-ray apparatus ~~of the invention having at least one LED on a filter array for illuminating the X-ray field according to an exemplary embodiment;~~

[0012] ~~Figure. 5, in~~ illustrates a detailed view, a filter array of Fig. 4, with at least one LED according to one exemplary embodiment.

#### DETAILED DESCRIPTION

[0013] ~~Figure. 1 shows a known mammographic X-ray apparatus 1 according to the related prior art. The mammographic X-ray apparatus 1 which as its essential components includes both an X-ray source 5 and a detector, in particular for example, an object table 2 equipped with an X-ray film. In~~ During an examination, the X-ray source 5 generates an X-ray beam 11, ~~which serves to that projects an object (image) (not shown), not explicitly shown, of a patient, which is to be examined, onto the detector. The mammographic X-ray apparatus 1 includes A~~ a diaphragm 4 ~~is disposed such that it can delimits the X-ray beam 11 by blanking out, collimating, (or blocking) some portions of the X-ray beam 11. Before an actual operation of making an X-ray image, an X-ray beam location on the surface of the patient or on the object table 2 is monitored by means of an illuminating beam 7 that is generated by an incandescent bulb 12. The illuminating beam 7 is and deflected~~ by a mirror 13 in the direction of the X-ray field. The incandescent bulb 12 and the

mirror 13 are adjusted, ~~so in such a way that~~ the illuminating beam 7 and the X-ray beam 11 are ~~essentially-substantially~~ congruent on the surface of the patient or on the object table 12. ~~In one exemplary embodiment, the mirror 13, in order not to hinder the X-ray beam 11, is either radiotransparent, in order not to hinder the X-ray beam 11. Alternatively, the mirror 13 or~~ can be folded out of the way of the X-ray beam 11.

[0014] ~~Figure 2 shows a different embodiment of a mammographic X-ray apparatus 1.1 of the invention. The mammographic apparatus 1.1 includes in which~~ a plurality of LEDs 6 ~~are disposed between an X-ray source 5.1 and a diaphragm 4.1, and. The illuminating beam 7.1 is directed in an undeflected fashion onto the X-ray field. In one exemplary embodiment, the illuminating beam 7.1 is undeflected when directed onto the X-ray field. For example, The~~ term "undeflected" does not preclude the use of lenses for correcting the illuminating beam within a range of up to 15°.

[0015] ~~In one exemplary embodiment, the LEDs are disposed between the X-ray source 5.1 and the diaphragm 4.1. The illuminating beam 7.1 of the LEDs is delimited by the diaphragm 4.1, by the positioning of the LEDs between the X-ray source 5.1 and the diaphragm 4.1, in such a way that the beam field of the illuminating beam 7.1 on the surface of the patient and/or on the object table 2.1 is essentially-substantially congruent with the X-ray field of the X-ray beam 11.1. The LEDs are disposed outside the X-ray beam 11.1. For example, the LEDs are distributed over its the X-ray beam's outer 11.1 outer circumference. Both the X-ray beam and the LEDs are protected from damage from each other. so that they neither damage the X-ray beam nor become damaged themselves by it.~~

~~Advantageously, According to one exemplary the embodiment, the LEDs are disposed on a common ring mount 10.~~

[0016] ~~Figure 3 shows a detailed plan view on one such illustrates a ring mount 10. The ring mount 10 includes with individual LEDs 6, and on the X-ray source~~

5.1 and on the X-ray beam 11.1, ~~which is~~ are shown in cross section at the level of the ring mount 10. As shown in Figure 3, The ~~the~~ ring mount 10 is embodied and mounted in such a way that the X-ray beam 11.1 can pass through ~~its center~~ the center of the ring without being unhindered. The ring mount 10 is on the X-ray source 5.1.

[0017] According to another exemplary embodiment, as shown in Figure 4, ~~shows an X-ray apparatus 1.2, as a second embodiment of the invention, includes with the mounting of at least one LED 6.2 mounted on a filter array 3 that is present per se. For the sake of greater brightness, a~~ Alternatively, a plurality of LEDs may also be provided mounted to increase the brightness. The filter array 3, which is mounted between the X-ray source 5.2 and the diaphragm 4.2 and, typically serves to move individual filters 8.1; 8.2; and 8.3 into the X-ray beam. The filters 8.1; 8.2; and 8.3 for filtering filter out frequencies not needed for the particular X-ray image to be made.

[0018] In one exemplary embodiment, T ~~the at least one LED 6.2 can advantageously be~~ is positioned in the filter array 3. The at least one LED 6.2 can be used, in particular instead of a filter 8.1; 8.2; 8.3, and can be ~~is~~ pivoted ~~be~~ able (swivelable) out of the X-ray beam 11.2. ~~For~~ When illuminating the X-ray field, the filter array 3 is pivoted (swiveled), ~~in such a way so~~ so that the at least one LED 6.2 is located ~~exactly~~ in the beam path of the X-ray beam 11.2, ~~and, t~~ The illuminating beam 7.2 is ~~essentially~~ substantially congruent with the X-ray beam 11.2.

~~Expediently, t~~ The at least one LED 6.2 may be is pivotable (swivable) out of the X-ray beam 11.2 by rotation of the filter array 3 about its longitudinal axis. ~~For making~~ When the X-ray image is being made, the required filters (8.1; 8.2; and 8.3) can be pivoted (swiveled) into the beam path ~~instead of the LEDs.~~

[0019] ~~Fig. 5~~ sure 35 ~~shows a more detailed view of~~ illustrates a filter array 3, ~~For example, the filter array 3 is used in the mammographic X-ray apparatus 1 shown schematically in Figure 4,~~ The filter array 3 includes with four mounts

~~intended for filters or LEDs;~~ According to one exemplary embodiment, three individual filters (8.1; 8.2; and 8.3) are inserted into mounts, and at least one LED 6.2 that is disposed in a the other mount in place of one filter. The present embodiments are not limited to this arrangement. For example, any combination of filters and LEDs can be used in the filter array.

**[0020]** While the invention has been described above by reference to various embodiments, it should be understood that many changes and modifications can be made without departing from the scope of the invention. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention. The invention can be summarized briefly as follows: In an X-ray apparatus, in particular a mammographic X-ray apparatus, having an X-ray beam generated by an X-ray source and delimitable by a diaphragm, for the sake of illuminating an X-ray field on the surface of a patient with little effort, LEDs are disposed as indicator means outside the X-ray beam and distributed over its outer circumference, between the X-ray source and the diaphragm, and the illuminating beam of the LEDs is directed in an undeflected fashion onto the X-ray field; in a further version of the invention, at least one LED is mounted, in such a way that it can be pivoted out of the X-ray beam, on a filter array that is mounted between the X-ray source and the diaphragm.



~~Abstract~~ABSTRACT

~~[0020]—[0021]~~ An X-ray apparatus and a mammographic X-ray apparatus are provided. The X-ray apparatus includes an X-ray beam generated by an X-ray source and a diaphragm. At least one LED is disposed as an indicator means between the X-ray source and the diaphragm. The illuminating beam of the at least one LED is directed in an undeflected fashion onto the X-ray field. The at least one LED may be pivotable (swivable) out of the X-ray beam. The at least one LED is mounted on a filter array that is mounted between the X-ray source and the diaphragm. The aim of the invention is to illuminate an x-ray field with little effort on the surface of a patient. Said aim is achieved by an x-ray apparatus, especially a mammographic x-ray apparatus (1.1), which comprises an x-ray (11.1) that is generated by an x-ray source (5.1) and can be delimited by a diaphragm (4.1) and in which LEDs (6) are disposed outside the x-ray between the x-ray source (5.1) and the diaphragm (4.1) as indicating means, said LEDs being distributed along the outer circumference of the x-ray (11.1). Furthermore, the illuminating beam (7.1) of the LEDs (6) is directed in an undeflected fashion onto the x-ray field. In a further embodiment of the invention, at least one LED (6.2) is mounted on a filter array (3) that is fixed between the X-ray source (5.2) and the diaphragm (4.2) such that said LED (6.2) can be swiveled away from the X-ray (11.2).